PERFECTLY MATCHED LAYERS FOR ELASTODYNAMICS OF UNBOUNDED DOMAINS

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One approach to the numerical solution of a wave equation on an unbounded domain uses a bounded domain surrounded by an absorbing boundary or layer that absorbs waves propagating outwards from the bounded domain. A perfectly matched layer (PML) is an unphysical absorbing layer model for linear wave equations that absorbs, almost perfectly, outgoing waves of all non-tangential angles-of-incidence and of all non-zero frequencies. Utilising insights obtained with electromagnetics PMLs, the authors have developed displacement-based (unsplit-field) PMLs for anti-plane and plane-strain motion of (visco-)elastic media, for both time-harmonic [1] as well as transient wave motion. These PMLs have been implemented using a standard displacement-based finite-element (FE) approach; the FE implementations, except the one for transient plane-strain motion, are symmetric. These FE PML models have been applied to the problem of the anti-plane motion of a semi-infinite layer on a rigid base, and to the classical soil-structure interaction problems of a rigid strip-footing on a i) half-plane, ii) layer on a half-plane, and iii) layer on a rigid base. Results from these problems demonstrate the high accuracy achievable by PML models using small bounded domains and at low computational costs. Extension of these PML models to three-dimensional problems is in progress.

References

[1] U. Basu and A. K. Chopra, "Perfectly matched layers for time-harmonic elastodynamics of unbounded domains: Theory and finite-element implementation", *Computer Methods in Applied Mechanics and Engineering*, v. 192, p. 1337-1375, 2003.